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ABSTRACT

A review of the literature on the use of the computer in teaching reading included studies that centered on basic reading skills and studies that, for the most part, supported the use of computer assisted instruction (CAI) to assist in developing these skills. The research indicated that CAI in reading is effective for a wide variety of reading skills and concept areas. Many researchers believed and produced evidence that the computer has already begun to bring students great benefits, such as better, more comfortable and faster learning of basic reading skills. CAI has been effective in raising reading achievement, especially when used to supplement regular teacher-presented instruction, and has produced a decided advantage in reducing the time taken to learn. Some investigators believed computers were more effective with younger students. The research dealt with diverse age levels, and varied from the intellectually handicapped to the gifted and talented. CAI has had a positive effect on student and teacher attitudes and motivation. A few research studies found no advantage in using CAI to increase student achievement since scores on post-tests were no better than those which involved only traditional methods. However, even those studies suggested that there were other advantages, such as student motivation, saving of teachers' time, savings of students' learning time, and opportunities for increased practice and reteaching. The computer is limited in its ability to contribute to this literacy only by man's capabilities and imagination. Thirty-four references are attached. (MG)

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THE IMPACT OF THE COMPUTER ON THE TEACHING OF READING: A REVIEW OF THE LITERATURE

Clarence L. Darter, Jr. and Lucy N. Phelps

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ABSTRACT

The use of computers is becoming more common in American schools. Literature was reviewed to determine computer capabilities in improving basic reading skills, application to students of all ages and abilities, and effect on student and teacher attitudes and motivation. The research indicated Computer Assisted Instruction (CAI) in reading was effective in improving reading skills and concept areas for various age groups and ability levels. Additionally, CAI had a positive effect on student and teacher attitudes and motivation. Computers are valuable additions to drill and practice of reading skills resulting in a better personalized tutoring program for all levels of students. Most studies found reading achievement was raised when CAI was used, particularly if it was used to supplement regular teacher-presented instruction.

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THE IMPACT OF THE COMPUTER ON THE TEACHING OF READING:
A Selected Review of the Literature

Rosario is embarking on the long path of education. His parents assist him as he assembles the personal computer system issued by his school. Educators are convinced the expenditure is economical since every child has access to individualized programs of learning which saves two years of work previously required. Rosario's system, the 27x, has a holographic projector, voice synthesizer and listening capabilities, digitizer light pens for drawing and writing, and touch response. Rosario's personal computer grades his work and transfers results by modem to his teacher's system. She has a continuous record of his skills mastery, grades and averages, and prescriptive recommendations.

Since Rosario has spoken mostly Spanish in his preschool years, his equipment includes a Spanish/English Automatic Translation Device with which he can call up the text in Spanish or English as his needs require. All the children have the Spelling Check Software Package and English Grammar/Usage Word Processing Program which give them immediate feedback on their errors. Rosario's textdiscs are all programmed with manipulations for four readability levels, background information, word definitions, and main-idea function.

In the future computer equipment and programs will likely be a reality for students in every American school. A new world of school and personal computing will meet the diverse needs of students. Seymour Papert said, "The computer is the Proteus of machines. Its essence is universality, its power to simulate. Because it can take on a thousand forms and can serve a thousand functions, it can appeal to a thousand tastes" (1980, p. viii). The computer will be a powerful tool, assisting reading instruction in almost every conceivable way. The learner can be explicitly directed or can be completely in control, free to follow the internal desire of curiosity and inventiveness.

As educators realize how much computers have to offer for the future in the teaching of reading, a number of ideas have been accepted. Computer-aided instruction for gifted students allows individualization in enrichment, critical thinking, and other areas of interest. For the slow learner, or the learner with disabilities, repeated practice is given in areas of difficulty or in new concepts. Immediate feedback reinforces correct responses or points out errors needing correction. These advantages are applied to the teaching of reading and offer a multitude of possibilities for assisting students in optimum reading development.

Despite these advantages, evaluation of computer applications should provide foundation knowledge for future development and expansion. To determine the present state of computer capabilities, literature was reviewed in three areas: effect of computer-assisted instruction in the teaching of basic skills in reading; impact of teaching using computers with different grades, ages, and ability levels of students; and changes taking place in student and teacher attitudes and motivation as a result of computer-assisted instruction.

Review of Literature

"At a time, when state and national commissions have consistently call for renewed emphasis on the teaching of reading and the other fundamental skills, an instructional technology with the computer's apparent promise ought to be carefully scrutinized" (Tanner, 1984, p. 35). Many authorities believe that in the school of the future, the microcomputer is the answer to handling, accommodating, and reducing complexity in both the student and the teacher aspects of education. Perhaps the teacher may take the role of a learning guide and the student may become more of an individual learner interrelating with the computer as the guide.

Computer-assisted Instruction in Teaching Reading

Computers have been studied as a means for developing the basic reading skills needed for successful reading ability. These skills fell into several broad areas including comprehension and retention, phonological word analysis, and vocabulary and sight word recognition.

Comprehension Skills and CAI. Researchers were not in agreement as to the effects of computer-aided instruction on comprehension and retention. Gambrell, Bradley, and McLaughlin (1987), and Kattman, Midgett, and Thompson (1983) reported no statistically significant difference in students' reading comprehension for computer-assisted instruction (CAI) than when they received traditional instruction.

In a print versus microcomputer-generated text study, urban students with mixed ethnicity of high ability reading levels showed no significant differences in performance while low ability reading students showed significant improvement (Feldmann & Fish, 1987). The microcomputer did not hinder the performance of poor readers any more than print. However, the microcomputer group scored significantly better ($p=.02$) than the print group on comprehension, and males using microcomputers performed better than females on the direction following task.

Computer-assisted instruction in language skills assisted volunteer tutors in improving students' reading skills (Duffy, Bowen, Langston, & McNealy, 1985). The program was designed to raise the reading level and increase the literacy retention of students. Through the use of questionnaires, interviews and observations, the study found tutors and students wanted the program as a supplement in remediation of reading comprehension difficulties.

Several researchers, however, found that CAI improved reading comprehension and achievement. Hunter and Kearsley (1981) reported a case study at Bennett College in which high-risk and remedial students were particularly assisted in the program. Many students' scores in reading were significantly increased when a teacher/technology combination was used. As a result, students were better prepared and completed programs in less time. Riding and Powell (1987) conducted a study using 64 five-year-olds who were divided into four similar groups. They cited significant improvement ($p < .05$) for those who had low initial reading attainment and did the computer activities compared to the low attainment control groups. Children in this low attainment group developed more efficiency in learning to read and in comprehension.

Roth and Beck (1987) took fourth graders from low socioeconomic backgrounds with a history of low reading achievement and instituted CAI programs for remedial instruction. Substantial improvements ($p < .01$) in comprehension at the word- and proposition-sentence level were noted, but no improvement was found at the passage level. Other processes improved were accuracy and efficiency of decoding and word recognition. While the study provided positive assessment of the enhanced achievement in basic skills, intense instruction and practice were seen as necessary to producing effective change for students whose skills were at the low end of development.

Reinking and Schreiner (1985) looked into the effects of computer-mediated text on measures of reading comprehension and reading behavior. Their results showed reading comprehension can be influenced by computer-mediated text, which was reflected in the mean score of the off-line group being higher on low-difficulty passages. Of particular interest were the text manipulations available to some readers in the study. The first group read traditionally printed pages and were tested on them. The second group read passages on-line and were tested. The third group read on-line and had several text manipulations available to

them, if they so chose. Manipulations available were definitions of key vocabulary words; a simpler, less technical version of the text; supplemental background information; and passage structure in the form of the main idea for each paragraph. The fourth group read on-line and were required to view all text manipulations before answering the questions. The fourth group made the most progress and improvement. The inclusion of these options in the computer-mediated text permitted readers to interact overtly with the text in a manner not easily replicated with conventional print technology.

> In sum, the present study points to potential applications of computer technology in mediating written text in ways which may affect comprehension. .....The advent of computer technology and the capability to achieve previously unavailable manipulations of print may, however, significantly affect typical reading behavior and the processing of written text (p. 550).

"Comprehension may increase if the computer can be used to relieve the processing burden placed on the reader and/or stimulate more active processing on the part of the reader" (Reinking and Schreiner, 1985, p. 539).

Phonological word analysis. Teaching-game structure for word analysis instruction served effectively for the teaching of principles and procedures in skills needed through providing students with independent practice activities in an enjoyable game format. Weaver et al. (1982), Roth and Beck (1984, 1987), and Frederiksen et al. (1983) reported substantial improvement in word attack skill development with the use of learning games and CAI. Using a hierarchal game model for training in developing particular reading components sequentially, Frederiksen et al. (1983) found learning games to be an effective way to build reading skills for secondary school students with poor reading skills. Weaver et al. concluded that the teaching-game method worked effectively and should have general applicability for others. Roth and Beck (1984, 1987) used the game format for developing low readers' word analysis skills and found that not only was the game format successful, but the learning transferred to other uses, such as word decoding skills, developing a word recognition strategy, and a greater attention to interior parts of words.

Vocabulary, sight words, and CAI. Two of four studies in the area of teaching of vocabulary and sight words noted considerable improvement in knowledge of words through the

use of CAI. Duffy et al. (1985) reported considerable success using computer instruction. The computer allowed literacy instruction to be individualized. Frederiksen et al. (1983) found that students with poor reading skills were able to reach levels of performance in word recognition in context that equaled or exceeded those of high ability readers.

However, Alfano (1985) found no difference in vocabulary development for a sample of low-average seventh graders given computerized instruction. Sudia (1985) presented another view. She investigated whether any differences occurred when 11 first grade children were taught sight words on the computer as compared with 11 children who were taught in the classroom using flashcards shown by the teacher. Sudia concluded from her results for a five week period that the group taught by the teacher on flashcards had a significantly higher score than those taught on computer. Kastler and Roser, as reported by Sudia, concluded that "'computers serve an important role in reinforcing the learning of reading, but they do not replace human interaction'" (Sudia, 1985, p. 7).

Application to Various Ages and Ability Levels

Beginning Readers. In teaching beginning readers, teachers felt computers saved time and promoted student

motivation. With a recent emphasis on critical thinking, Riding and Powell (1987) conducted a study on the effect of reasoning and reading performance of computer-presented critical thinking activities in five year old beginning readers. Results showed significantly greater improvement ($p = .01$) for the treatment group. Of particular interest was the superior reading attainment by the low initial attainment subjects. In another study, Casey (1984) found that the use of the microcomputer with speech synthesizer enhanced beginning reading instruction.

"Writing to Read" is a computerized writing and reading program that was used in many schools. "When children begin writing and reading simultaneously a symbiotic relationship appears to be established in which each process was stronger than either could be alone" (Spillman and Lutz, 1986, p. 265). Working in pairs for about fifteen minutes each day, the children worked through sequenced, self-paced computer cycles to learn letter-sound correspondences. In addition, electric typewriters were available for practice in typing words, sentences and eventually stories. Teachers encouraged the children to spell words the way they sounded.

Three recent studies reviewed "Writing to Read" programs (Naron, 1986; Spillman et al., 1986; & McBeath, 1986). McBeath reported that students' scores were

significantly higher than those of the comparison group. She also commented that the scores of the first grade students in the program were not as high as expected when looking at the kindergartners' achievement level. Spillman et al. (1986) reported from Lee County, Florida, that results showed writing samples from the students using the computer program contained twice as many communication units as those of the control group. The findings made a strong statement for the inclusion of computers and the LEA approach through "Writing to Read."

The Fort Worth Independent School District researched a two year program with "Writing to Read" (Naron, 1986). The results with respect to the outcome measures of reading and writing were much weaker than expected. Problems involved numerous equipment failures and considerable expense. Teachers felt the program was better suited for some kindergarten and first-grade students than others. They also believed it was an exciting but expensive program for the results achieved.

Developing readers. Some researchers, such as Kattman et al. (1983), Alfano (1985), Kochinski (1986) and Gambrell et al. (1987), used children in the middle grades and were convinced that the use of CAI made no difference in the learning of developing readers. Others (Roth and Beck,

1984; Ragosta, Holland, and Jamison, 1982) found significant differences in children's learning as a result of CAI.

Zuk and Danner (1986) studied the effects of microcomputers on children's attention to reading tasks. They concluded that children preferred the computer tasks to print but did not perform better, were not on-task any more often, did not stay on-task longer, and did not comprehend any better when reading from the computer.

Another interesting work used interactive fiction. Lancy and Hayes (1986) attempted to determine whether students in grades five through eight, whose interest in reading was at an average level, would become more interested in reading if they used interactive fiction computer games involving a quest or solving a problem in conjunction with required reading. Although a considerable amount of reading was required in most of the programs, students did not react negatively. If they were successful at carrying forward with the quest, students, with no more than average interest in reading, were willing to spend large amounts of time engaged in interactive fiction even though heavy amounts of reading was required. They also discovered that interactive fiction encouraged developing readers to read independently, thereby increasing reading abilities.

Readers with special problems. CAI produced positive results with children who had special reading problems. Ragosta et al., (1982) and Ragosta (1983) studied the use of CAI with compensatory students. The programs were effective for learning accomplishments with these students. Jones, Torgeson, and Sexton (1987) concluded that learning disabled children improved substantially in speed and accuracy after the use of CAI to promote fluency. Intellectually handicapped school children improved and retained that improvement after a year, as reported in Lally's study (1981). Lally believed this type of instruction had much to offer intellectually handicapped students in areas of handwriting, reading, and concept development. The problems of severe and profound hearing impaired students were addressed by Prinz and Nelson (1985). These students were found to improve as a result of the CAI programs combined with exploratory learning.

Others concluded that CAI had little effect or made no difference in students' progress as demonstrated by its contrast with traditional methods. Bass, Ries, and Sharpe (1986) reported CAI use with low achievers resulted in little difference as compared to traditional methods. Kleinmann's study (1987) was concerned with students who were learning English as their second language (ESL). He

found CAI was not more effective than similarly constructed instructional programs that lacked a CAI component.

The drill and practice nature of much of the present CAI software was advantageous when students in these special categories needed to spend more time in learning particular skills. The endless possibilities for individualizing learning for these students was a great time saver and help for the planning teacher.

Student and Teacher Attitudes and Motivation

All but one of the studies reviewed showed that both students and teachers favored the use of the computer as supplemental to traditional classroom instruction. Bass et al. (1986) reported that CAI resulted in equal or better achievement in less time and with more positive student attitudes than traditional instruction. Cicchelli and Richards (1983) stated, "The student enthusiasm for working with the computer is universal..... The hyperactive students will engage themselves attentively while working at the computer, but will fail to do so while involved with classroom seatwork" (p. 8-9).

Although students are highly motivated by the use of CAI, Duffy et al. (1985) believed students did not accept tutoring without a human tutor or teacher. They strongly

valued the emotional support as well as the range of feedback the tutor provided.

One advantage of CAI was the learner's control over instruction. Learners could, for instance, enjoy the freedom of choice and proceed at their own rates. Reinking and Schreiner (1985) found evidence, however, that students' ability to recognize when they have been successful, may not have been sufficiently mature enough to benefit from learner control in computer-presented textual choices.

Students and teachers appeared to appreciate the characteristic of immediate feedback available in computer lessons. Many believed this to be one of the greatest advantages of CAI. However, some believed feedback must be accompanied by an explanation of why the answer was incorrect. Without this informative feedback, the value of feedback was negated. Informative feedback was not included in many available programs.

Many educators feared students' reactions to being placed in computer work stations for numbers of hours to work independently. Again, a variety of researchers reported increased social interaction revolving around the computer applications as students asked one another for help and advice (Duncan, 1985). Some believed boys to be more adept and to have more aptitudes for computer activities

than girls, as well as tending to be willing to work at the computer for longer periods of time (Hawkins, and Schrock et al., as cited by Balajthy, 1987).

Most teachers, as well as students, had positive attitudes toward computers. Bass et al. (1986) stated that, "Although participating teachers expressed positive comments about using microcomputers in the classroom, they were sometimes reluctant to give up their direct instructional time with students" (p. 217). However, most teachers did not hesitate to agree that a combination of technology and the personal touch was the best method for promoting student growth. Teacher acceptance of CAI was, at times, less than wholehearted. But one such instance showed teachers changed their attitude from the beginning of the study and were most enthusiastic about the help CAI gave in improving students' skills (Ragosta et al., 1982).

Computers are particularly helpful in saving both teachers' and students' time. The computer reduced substantially the amount of time students needed for learning (Hunter & Kearsley, 1981; Bass et al., 1986; Blanchard, as cited by Alfano, 1985). Teachers found them most helpful in providing drill and practice for needed skills through varied and lively formats. CAI allowed children to choose activities and provided automatic pacing

and feedback. The teacher was greatly assisted in her work through programs that helped her simplify her tasks (Pittelman & Levin, 1985), such as in revising letters, printing posters, signs, and greeting cards. Programs are also available that keep children's records and grades. Although such use of technology was not a direct educational priority, it improved the working climate and led to positive teacher attitudes.

Conclusions and Implications

The review of literature included studies that centered on the basic reading skills and studies that, for the most part, supported the use of CAI to assist in developing these skills. The research indicated CAI in reading was effective for a wide variety of reading skills and concept areas. Many researchers believed and produced evidence that the computer has already begun to bring students great benefits, such as better, more comfortable and faster learning of basic reading skills. Computers provided opportunities to work with vastly richer materials and more sophisticated programs. The programs personalized tutoring, as well as drill and practice. Computers automatically diagnosed individual reading difficulties, prescribed remedies for

problems, kept records of student progress, and presented results in print and diagram form.

CAI was effective in raising reading achievement, especially when it was used to supplement regular teacher-presented instruction. Also, CAI produced a decided advantage in reducing the time it took to learn.

Some investigators believed computers were more effective with younger students. However, CAI was very effective with all ages and ability groups. The research dealt with various ages, and varied from the intellectually handicapped to the gifted and talented. CAI did indeed make a contribution to the learning of each particular age or ability group.

CAI had a positive effect on student and teacher attitudes and motivation. Some credence was given to the reasoning that increased social interaction took place when students were involved in asking for help and in assisting others in computer tasks. Some believed that computers isolated students from one another, but most did not consider it to be a problem. An increase in positive attitudes and interaction was seen in classrooms using CAI. Especially motivational was the chance for students to be in control of learning through the use of programs such as word processing, data manipulation, and exploration tools, such

as Logo. The learner became free to follow the stimuli of his own imagination and ingenuity. Creativity associated with CAI brought students to the highest levels of critical thinking. Such motivation was a driving force that caused students to reach for the pinnacle of learning.

A few research studies found no advantage in using CAI to increase student achievement. Scores on post-tests were no better than those which involved only traditional teaching methods. However, even these studies suggested that there were other advantages, such as those of student motivation, saving of teachers' time, savings of students' learning time, and opportunities for increased practice and reteaching.

Time on the computer is a valuable commodity. Computer time is of utmost value to Rosario and to others like him. He needs the extra incentives and productive home and school computer lessons that CAI will provide to motivate him to the heights of learning. Time on the computer will assist Rosario to explore things in ways which otherwise would have been difficult, if not impossible. The computer was not found to be a panacea to all reading ills, and it is not a passing fad. The computer is a valuable tool to be used as part of the equipment of learning to read. This tool is a

unique but realistic marvel with potentially enormous impact upon the teaching of reading.

Education provides our children with the intellectual tools needed for the technological world of the future. The foundation of education was laid upon literacy and particularly on the ability to look at print, either technologically or traditionally, and derive from it the ideas contained therein. The computer is limited in its ability to contribute to this literacy only by man's capabilities and imagination. Already, the computer has contributed greatly in the acquisition and development of reading skills.

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